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SERIE: FISKERI · BIND VI

Nr. 6. Johs. Schmidt: CONTRIBUTIONS TO THE KNOWLEDGE OF THE YOUNG OF THE SUN-FISHES *(MOLA* AND *RANZANIA)*.

KØBENHAVN
C. A. REITZEL, BOGHANDEL
BIANCO LUNOS BOGTRYKKERI
1921

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CONTRIBUTIONS TO THE KNOWLEDGE OF THE YOUNG OF THE SUN-FISHES (*MOLA* AND *RANZANIA*)

BY

JOHS. SCHMIDT

KØBENHAVN
C. A. REITZEL BOGHANDEL
BIANCO LUNOS BOGTRYKKERI
1921

It has long been known that there exist two very different types of sun-fishes, named by English zoologists the short sun-fish *(Mola rotunda* or *Orthagoriscus mola,* Fig. 1) and the oblong sun-fish *Ranzania truncata* or *Orthagoriscus truncatus,* Fig. 2) respectively. As the illustrations show they vary greatly in appearance. This is also true as regards size; for whereas the short sun-fish attains a length of $2^1/_2$ meters or more, the oblong sun-fish seldom exceeds 70 cm. in length, with a maximum of 90 cm. In comparison with the short species it may most appropriately be designated a dwarf.

Fig. 1. *Mola rotunda* (= *Mola rotunda,* Murray & Hjort (1912)). Length: 211 cm. — Copy of the figure by Murray & Hjort (1912).

Whilst it was the universal opinion that no specific differences existed among sun-fishes of the oblong type, there have however in former times been described a number of species of short sun-fishes. Detailed information of the latter may be found in a work by Steenstrup & Lütken (1898) which examines the earlier records and reproduces the often quite fantastic illustrations of the old authors. There is now no longer any necessity to concern ourselves with all these old "species" of *Mola,* which Günther in his catalogue (1870) rightly groups into one single form *(Orthagoriscus mola).* It is, however, otherwise with the other short sun-fish *(Orthagoriscus lanceolatus)* from Mauritius, which Günther on the strength of Liénard's description (1841) included in his catalogue, but whose claim to rank as a separate species has recently been questioned. As may be seen from Fig. 3 — a copy of Liénard's figure reproduced by Steenstrup & Lütken (1898) — Liénard's species, of which only two examples, from Mauritius, were known, is remarkable for its pointed tail, the shape of which may be compared very aptly with the shape of the tail of a male crab. A similar form *(Orthagoriscus oxyuropterus),* of which only one specimen from Amboyna is extant, was described by Bleeker in 1873, who however was inclined to regard it as identical with that of Liénard from Mauritius. It would therefore seem that pointed-tailed sun-fishes were extremely rare and only to be found in the Indian area, when the Prince of Monaco in July 1887 from his yacht "Hirondelle" harpooned a large specimen in the Atlantic west of the Azores. As is seen in Fig. 4 the tail of this specimen tapers to a point in contrast to the case in the ordinary short sun-fish. Collett in working up the Prince's collection nevertheless classifies it as an ordinary short sun-fish *(Mola mola* — synonym for

Mola rotunda). In this connection he discusses the question of regarding the pointed-tailed type as a separate species and answers it in the negative. He had previously seen a young sun-fish, abt. $3^1/_2$ cm. long, and remarked that its tail tapered to a point, and he assumed that the few adult specimens having pointed tails are due to the retention of this post-larval characteristic[1].

Later on the question was discussed by STEENSTRUP & LÜTKEN (1898) who recognise LIÉNARD's and BLEEKER's Indian sun-fish as a separate species, *Mola lanceolata.* They state inter alia the following (l. c. p. 54): "Hitherto it is unknown in the Atlantic Ocean; in this connection however it should be remembered that LOWE says of the (or a) sun-fish caught near Madeira, that its tail was not stunted, as invariably depicted of the European form, but tapered to a short point in the centre — a description which seems applicable to *Mola lanceolata.* It may be mentioned that the sun-fish captured by the Prince of Monaco (vide COLLETT l. c. Pl. VI) had the tail in the centre tapering to a point, as found also in a *Mola*-young in our museum;[2] which is possibly a hint that *Mola lanceolata* also occurs in the Atlantic or that at all events some such variety of *Mola rotunda* is to be found there" (translated from the Danish text).

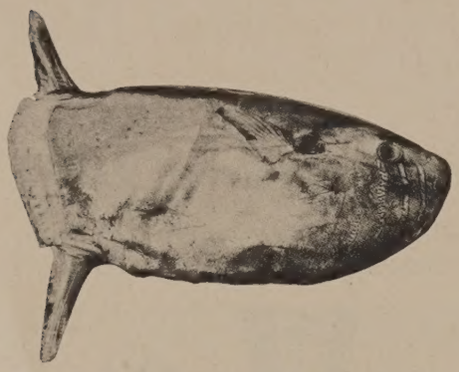

Fig. 2. *Ranzania truncata.* (= *Orthagoriscus truncatus*, Beauregard (1893)). Length: 65 cm. — Copy of the figure by BEAUREGARD (1893).

In the collections made by the Danish Deep Sea Investigation Commission there occurs considerable material relating to larval and post-larval stages of sun-fishes. An examination of this material caused me to realise very quickly that the whole subject of species-delimination was in need of revision. By referring to various museums I succeeded, through the extreme courtesy of the directors, in collecting together some of the most important original specimens of young sun-fishes described in the literature on the subject. A study of these in connection with my own material has made it possible for me to obtain a, as I hope, accurate result.

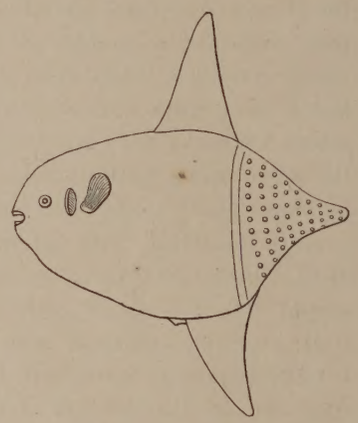

Fig. 3. *Mola lanceolata* (= *Orthagoriscus lanceolatus*, Liénard (1841)). Copy of the figure by LIÉNARD (1841) reproduced by STEENSTRUP & LÜTKEN (1898).

The main points are as follows. In addition to *Ranzania*, the oblong sun-fish, there exist in all three oceans two species of short sun-fishes *(Mola)*, namely the well known round-tailed *Mola rotunda* and a pointed-tailed: *Mola lanceolata.* The latter is a quite distinct species which plainly differs, also in larval characteristics, from *Mola rotunda.* Hitherto only one adult specimen of *Mola lanceolata*, that secured by the Prince of Monaco, is known from the Atlantic, it having been incorrectly described by COLLETT as an abnormally developed specimen of *Mola rotunda.* My collections of tiny young shows that *Mola lanceolata* must be very common in the Atlantic and that it propagates in the Sargasso Sea. Similarly I have ascertained that the majority of the $1^1/_2$—5 cm. long young stages, described in literature as belonging to *Mola rotunda* (e. g. by PUTNAM, RYDER, PERUGIA, COLLETT) or *Ranzania truncata* (STEENSTRUP & LÜTKEN) are in reality young forms of the supposed rare *Mola lanceolata.* Hence

[1] "Le prolongement du milieu de la caudale et une formation normale dans la première phase des alevins; mais il disparaît complètement avec l'âge, et c'est seulement par exception, comme chez l'exemplaire de l'"Hirondelle", que ce caractère de jeunesse est conservé toute la vie". (COLLETT, l. c. p. 168).

[2] In this instance STEENSTRUP & LÜTKEN have hit very near the truth, for the *Mola* young to which they refer (identical with the accompanying reproduction Pl. I Fig. 6) is actually a young *Mola lanceolata.* Nevertheless later in their essay (l. c. Pl. IV Fig. E) they describe and depict it not as belonging to the genus *Mola* but as *Ranzania truncata*, a circumstance which has contributed in a high degree to add to the confusion.

it follows that one must be prepared to find that a greater or less proportion of the available observations made by sailors or others round about the oceans, of short sun-fish floating at the surface, refer in reality to *Mola lanceolata* and not as supposed to *Mola rotunda*. The harpooning by the Prince of Monaco of a large *Mola lanceolata* proved that this species, like *Mola rotunda*, travels at the surface.

I shall in this connection concern myself only with the somewhat older, $1^1/_2$—6 cm. long, developmental stages of sun-fishes discussed in literature or borrowed by me from various museums. The treatment of the youngest larval and post-larval stages, of less than 1 cm. in length, must be postponed, as the material is not yet fully sorted and therefore cannot for the moment be examined from a biological and geographical standpoint. I draw attention, however, to the fact of my having published a short article on these youngest stages in "Nature" of March 17, 1921.

I employ with pleasure this opportunity of expressing my best thanks to the following naturalists for loan of material or investigation of material in the museums: Mr. C. Tate Regan (British Museum), Prof. L. Roule (Paris), Prof. H. F. Nierstrasz (Utrecht), Prof. Ad. Jensen (Copenhagen) and Prof. P. Pappenheim (Berlin).

In arranging the material I have been most ably assisted by Messrs. P. Jespersen, M. Sc. and Å. V. Tåning, M. Sc., whilst Dr. Ø. Winge has undertaken the photographing of the material. I beg them therefore to accept my hearty thanks.

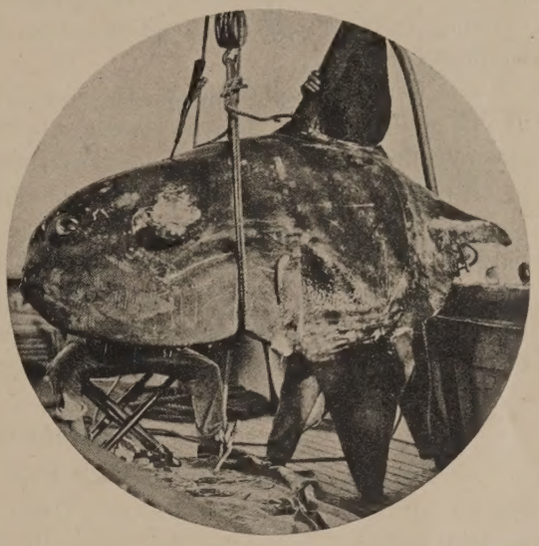

Fig. 4. *Mola lanceolata.* (= *Mola mola*, Collett (1896)). Length: 200 cm. — Copy of the figure by Collett (1896).

Since the latter half of the 18th century there have been known to science some small spinous fishes, varying in length from hardly two to abt. 5—6 cm. which since Linné's time have been considered to be related to the sun-fishes. The first illustrations as far as I know are given in 1766 by Koelreuter, who called his species *Mola aculeata*. Subsequently they have been several times discussed and depicted in literature under many and various generic names *(Mola, Orthagoriscus, Diodon, Acanthosoma, Pallasia, Molacanthus* etc.*)* I refer hereon to Steenstrup & Lütken (l. c.), who deal with the older literature in details. The majority of the above-mentioned names hint at a relationship with the sun-fishes, but it is not, however, until later that this possible connection is made a subject of full scientific investigation.

Fig. 5. *Mola rotunda* (= *Molacanthus palassii*, Putnam (1871)). Copy of the figure by Putnam (1871).

Among recent authors Steenstrup & Lütken (1863) have made out a strong case that these diminutive fish are immature forms of the sun-fishes and that the genus "*Molacanthus*" under which they were often classified must therefore be deleted. To this theory Günther (1870, 1880) subcribes himself. Meanwhile the American Putnam (1871) published a treatise wherein he challenges the correctness of Steenstrup & Lütken's hypothesis and claims that *Molacanthus* is an independent genus having no connection with *Mola*, and moreover declares himself especially confident of being able to prove the same by means of an anatomical investigation. Other authors followed Putnam's lead, for example his two fellow-countrymen Jordan & Gilbert who (1882 p. 865) express themselves with great positiveness, in that they state: "These small fishes have been generally considered as the young of *Mola*. The fact that they are not so was first conclusively shown by Prof. Putnam". It was however not long before it was shown by the American Ryder in a very carefully reasoned work (1886) that Putnam's position was untenable, and since then no-one, so far as I am aware, has ventured to dispute on scientific grounds that "*Molacanthus*" are immature forms of sun-fishes.

In the final work wherein the question is made the subject of closer investigation it is several times mentioned by STEENSTRUP & LÜTKEN (1898) who after 35 years of silence, return to the matter and discuss it very thoroughly, unfortunately without being acquainted with RYDER's valuable treatise. STEENSTRUP & LÜTKEN uphold their old theory from 1863, that "*Molacanthus*" must be deleted from the system and polemise in this connection with justice against PUTNAM. On the other hand their attempts to identify more closely the young sun-fishes with which they are acquainted from nature and from literature have not been successful. On one particular point they have committed a greater error than PUTNAM, by confounding the two types *Mola* and *Ranzania*, so that the result on the whole must be regarded as a worse confusion than ever.

In my above-mentioned article in "Nature" of March 1921 I have pointed out that tiny larvae of the sun-fishes have only been referred to three times in literature. First by Sir J. RICHARDSON (1844—48); secondly by STEENSTRUP & LÜTKEN (1898) and thirdly by SANZO (1919). I was in a position to show that in all three cases it was the larvae of the oblong sun-fish (*Ranzania truncata)* that was illustrated, whereas on the other hand tiny stages such as those of the genus *Mola* (4 mm. or less in length) do not seem to have been figured or mentioned in literature up to now. The situation is thus remarkable; for whereas the few larval (less than 4 mm. long) stages of the sun-fishes mentioned in literature have proved to belong to *Ranzania*, conversely the somewhat older stages (abt. $1^1/_2$—6 cm. in length), illustrated and discussed much more frequently, are with but one exception the young of *Mola*.

I. *Ranzania truncata*, the oblong sun-fish.

Only one specimen of the over 1 cm. long sun-fish larvae mentioned in literature belongs to this species. It is illustrated by HARTING (1865, Pl. II, Fig. 2) and has a length of circa 5,3 cm.[1] It is not made the subject of further discussion, the sole fact mentioned being that it was found in the stomach of a tunny captured in the Atlantic. The specimen[2] is preserved in the Zoological Museum at Utrecht, whence I borrowed it for examination. This exceptionally well preserved specimen, the length of which is 53 mm. and its greatest height 19 mm., is depicted in Pl. I, Fig. 7. There has been no hesitation at all in assigning it to *Ranzania truncata;* it possesses in a pronounced degree the elongated form which characterizes the species, causing HARTING (l. c. p. 12) to declare: "Or, en confrontant sa figure avec celle de la même espèce donnée par M. YARREL, on verra tout de suite que les deux figures se ressemblent tellement, au moins quant aux contours, qu'elles paraissent comme calquées l'une sur l'autre". True, this gives me no occasion for further consideration, but it is of importance to have established that *Ranzania* — which indeed in comparison with the *Mola* species may most aptly be called a dwarf-species — already at a length of 5,3 cm. has an equally or even more elongated form as the adult fish. In the earlier post-larval stages its shape is quite otherwise, for the height is much greater than the length (v. Fig. 13—14, p. 12).

II. *Mola*.

The young described in literature, *Molacanthus* etc. measure as stated abt. 1—abt. $5^1/_2$ cm. in length. At this point there is a great gap in the series of development as the smallest known adolescent specimen of a *Mola* is abt. 30 cm. long. Several specimens are discussed at various places in literature, but unfortunately as regards locality in very few cases are exact data given. The majority of the specimens seem to have been found in the stomachs of large pelagic fish *(Coryphaena, Thynnus* etc.*)*.

[1] The length of the individuals is always measured here as the distance between the mouth and the centre of the hindmost part of the body without including the rays of the caudal fin.

[2] Under a Röntgen examination the specimen was found to have 9 + 10 vertebrae, the same number as found by BEAUREGARD (1893) in an adult *Ranzania*. In several postlarval specimens 5—7 mm. long collected by the "Dana" in the Sargasso Sea in 1920, Å. V. TÅNING likewise found 9 + 10 vertebrae.

As mentioned before STEENSTRUP & LÜTKEN (1898) are the last authors to attempt to classify young sun-fishes, and in addition they have examined the majority of the specimens described by earlier writers. It may be assumed therefore that the quickest way to reach a definite conclusion would be to make a closer study of the specimens, upon which STEENSTRUP & LÜTKEN based their classification. By great good fortune I have been enabled to examine these specimens, which are all preserved in the museums at Paris and Copenhagen. An illustration will be found of them all on Pl. I as well as of a specimen originating from the museum at Utrecht (comp. REUVENS 1894) which supplements the other material. All the illustrations are reproduction of photographs taken by Dr. Ø. WINGE and revised by Å. V. TÅNING M. Sc.

Fig. 6. *Mola rotunda.* Copy of the figure by STEENSTRUP & LÜTKEN (1898) T. IV, Fig. A.

Before describing these specimens more closely, I must mention that STEENSTRUP & LÜTKEN (1898) have endeavoured to describe the spines characterising young sun-fishes. I reproduce (in Fig. 6) their Fig. A, Pl. IV — which depicts the same specimen as I have given in Fig. I in Pl. I. As is apparent STEENSTRUP & LÜTKEN attribute 7 unpaired spines to the middle part of the creature's body, indicated by the numbers 1—7. On either side of the body there are 8 spines, marked on the right side by even, on the left by odd numbers. They run along each side in two series, the lower (with the numbers 8, 10, 12, 14 on the right, 9, 11, 13, 15 on the left side) reaching from the portion below the mouth to just behind the base of the pectoral fin, the upper (numbered respectively 16, 18, 20, 22 and 17, 19, 21, 23) from the portion above the eyes to off the dorsal fin. I draw attention especially to the unpaired spine No. 1 in the middle of the forehead (frontal spine) and the paired spines No. 16 and 17, one on each side immediately above the eyes (eye spine).

As is evident from the accompanying Pl. I and as STEENSTRUP & LÜTKEN in opposition to other authors have correctly observed, the specimens group themselves naturally into two groups — I call them temporarily A and B, the former comprising the figures 1—3, the latter the figures 4—6.

Group A, attributed by STEENSTRUP & LÜTKEN to *Mola rotunda* is remarkable for its very elevated shape, its rounded lower-profile, its short and stout spines, the relative weakness of the unpaired frontal spine (No. 1) being very weak and the relative strength of the eye-spines (Nos. 16 and 17). Even in the case of the largest specimen, Fig. 3, almost 4 cm. in length, the height of the body is considerably greater than its length.

Group B, attributed by STEENSTRUP & LÜTKEN to *Ranzania truncata* may be recognised by its less elevated shape, by the fact that the lower contour forms a distinct angle, and by the great length of a number of its spines (Nos. 1, 3, 5, 12 and 13), whereas the eye spines (Nos. 16 and 17) are rudimentary or missing altogether. The difference in their appearance can bee seen very clearly in the two front views in Figs. 2a and 4a. In the largest specimen the body is essentially longer than high and the caudal fin has here a thread-shaped prolongation slightly above its centre.

STEENSTRUP & LÜTKEN as before mentioned attributed the individuals in Group B to the oblong sun-fish *(Ranzania truncata)* but this is certainly incorrect, which can be proved instantly by a comparison of the young *Ranzania* depicted in Fig. 7 Pl. I with the specimens in Figs. 4—6. This is shown by an examination of the number of fin-rays. As will be at once remarked, the number of fin-rays in the individuals in Figs. 4—6 does not coincide with those known in *Ranzania,* whereas the one depicted in Fig. 7 on the contrary has the same number.

In order to arrive at a result with regard to the classification of the specimens in Groups A and B it will be necessary to investigate which total is quoted in literature as regards the rays in the various fins of the sun-fishes.

[1] Later on SANZO (1919) has described the spines of a 2,8 mm. long specimen of "Orthagoriscus sp." and in contrast to STEENSTRUP & LÜTKEN marked them with letters. — As mentioned in my article in "Nature" March 17, 1921, SANZO's specimen belongs to *Ranzania truncata.*

In agreement with the view expressed at the beginning of this paper, I draw a distinction between the genera *Mola* and *Ranzania* and, within the former, between the round-tailed species *(Mola rotunda)* and the pointed-tailed species *(Mola lanceolata)*, in that I attribute to *Mola rotunda* all hitherto found specimens of *Mola* with the exception of the 3—4 pointed-tailed examples described respectively by LIÉNARD, BLEEKER and COLLETT, together with a specimen in the Berlin museum, collected by KLUNZINGER in the Red Sea. The latter individual has been examined both by COLLETT (1896 p. 167, foot-note) and by STEENSTRUP & LÜTKEN (1898 pp. 52—53).

As regards the number of fin-rays in *Mola rotunda*, various data are supplied by STEENSTRUP & LÜTKEN (1898). They give the following figures (in specimens from European waters).

Pect.	Dors.	Caud.	Anal.	D. + A. + C.
12	17	12	14	43
12	18	12	16	46
13	19	12	18	49
—	18	14	14	46
12	18	12	17	47
12	17	12	16	45
12	17	—	16	—
—	17	13	16	46
13	18	13	16	47
13	19	17	18	54
13	20	12	18	50
13	18	13	16	47
13	18	14	16	49

In the few adult pointed-tailed *Mola* that are known, the following numbers have been found:

Pect.	Dors.	Caud.	Anal.	D. + A. + C.	
9	20	23	16	59	(BLEEKER, 1873)
?*	24	19	21	64	(LIÉNARD, 1841)
9—10	—	—	—	—	(Spec. No. 10302) in the Berlin Museum, from Koseir, Red Sea, Coll. KLUNZINGER, according to information kindly supplied by P. PAPPENHEIM).

For the sake of completeness I also quote some countings of the fin-rays in *Ranzania truncata:*

Pect.	Dors.	Caud.	Anal.	D. + A. + C.	
13	18—19	18—19	19	55—57	(STEENSTRUP & LÜTKEN, 1898)
13—14	17—19	18—22	19	54—60	(GÜNTHER, 1870)
13	19	20	19	58	(BEAUREGARD, 1893)

The main result of the above data as far as Mola are concerned may be summed up as follows:

The round-tailed Mola *(Mola rotunda)* has a large total of rays in the Pectorals (12—13) and a small total in the unpaired fins (nearly always under 50).

The pointed-tailed Mola *(Mola lanceolata)* has a small total of rays in the Pectorals (9—10) and a large total in the unpaired fins (59—64).

Finally, *Ranzania* has a large total both in the Pectorals (13—14) and in the unpaired fins (over 54).

* LIÉNARD gives 17 rays in the Pectorals, but this must be due to a mistake of some kind or other. BLEEKER considers it probable that the number should be read 1 + 7 = 8.

In the original specimens illustrated on Pl. 1, Å. V. TÅNING found the following totals of fin-rays, in as far as it was possible to count them. It is to be noted that the figures depend partly on an estimate where the boundary between the dorsal and caudal fin and between the caudal and the anal fin is to be placed.

Mola.

	Fig.	Length mm.	Pect. dect.	Pect. sin.	Dors.	Caud.	Anal.	D+C+A
Group A.	1 (Paris)	15	13	13	16?	18?	14—15	48—49?
	2 (Paris)	19,5	13	13	15?	17—18?	15—16?	47—49?
	3 (Utrecht) ...	37	12?	12	16—17	19	14	49—50
Group B.	4 (Copenhagen)	23	10	10 (11)				
	5 (Paris)	25	10	?				
	6 (Copenhagen)	47,5	11	11?	21	20	17	58

Ranzania.

Group C.	7 (Utrecht)....	53	13	13	18 (19)	22 (21)	19—20	59—60

One remarks that the numbers in Fig. 7 Pl. I (the young one depicted by HARTING) correspond closely with the above quoted fin-formula in *Ranzania truncata*, to which species on other evidence also it undoubtedly belongs.

Of greater interest are the figures for the other specimens, those belonging to the genus *Mola*.

It is clear therefore that the specimens analysed in Group A, noticeable for very elevated shape, rather rounded lower contour and short, stout spines (of which the frontal spine (No. 1) is extremely minute but the eye spines (Nos. 16, 17) on the contrary distinct) boast the same high total of rays in the pectorals (12—13) and the same low total of rays in the unpaired fins as *Mola rotunda*. In contrast to these are found Group B's individuals, having a low total of rays (10—11) in the pectorals, and — as far as it has been possible to ascertain — a high total in the unpaired fins, i. e. the same characters as in the case of the pointed-tailed *Mola*, which I group with LIÉNARD's *Mola lanceolata*.

In our collections from temperate and tropical parts of the North Atlantic (1911—1920) there is found a considerable number of still younger stages (length 10 mm. and less), remarkable for the fact that spines Nos. 1, 3, 5, 12 and 13 are greatly elongate. They all correspond exactly as regards the low total of rays in the pectoral fins (9—11) and the high total in D—C—A, and agree in these respects closely with the specimens above collected in Group B.

As I assume that the *Mola* genus consists of two species only, I attribute Group A's members to the round-tailed *Mola rotunda* and Group B's to the pointed-tailed *Mola lanceolata*. Thus I agree with STEENSTRUP & LÜTKEN that Group A belongs to *Mola rotunda;* on the contrary Group B in my opinion does not — as these writers consider — belong to *Ranzania truncata*, but to the other less known and disputed Mola species: *Mola lanceolata*.

This decision, which is strongly based upon the proved agreement in the number of fin-rays in the young in question and the few specimens extant of *Mola lanceolata* from the Indian Ocean, is supported in addition by other facts. We have seen that the caudal fin in the largest specimen of Group B, depicted in Fig. 6 Pl. I, ends in a thread-shaped continuation. A closer examination reveals that the elongated part contains 7—8 rays, which are finer and on the whole more closely packed than the other rays in the caudal fin. We find the same state of things discussed by COLLETT (1896 p. 166—167) in the 2 m. long, pointed-tailed *Mola* (v. Fig. 4) harpooned from the yacht "Hirondelle" west of the Azores and regarded by COLLETT in his refusal to recognise *Mola lanceolata*'s claim to species, as an abnormally developed specimen of the common *Mola rotunda*. Of this specimen, apart from the photograph reproduced in Fig. 4, p. 5, nothing has been preserved except the end of the tail which was cut off and kept in salt.

COLLETT writes l. c. in this connection: "Nous avons ici une particularité qui est sans doute individuelle. A l'état normal, la caudale, chez *Mola mola*, est munie d'environ douze ou seize rayons, qui sont très éloignés l'un de l'autre et relativement courts; mais chez cet individu les deux rayons du milieu se sont separés en plusieurs rayons longs, minces, d'environ deux centimètres et demi de longeur, qui ont continué à grandir jusqu'à former ce prolongement particulier. Il y a dans ce prolongement environ sept de ces minces rayons, dont les moyens atteignent l'extremité du lobe caudal".

After COLLETT's description there can be no doubt that the Prince of Monaco's *Mola* and the specimen depicted in Fig. 6 Pl. I belong to the same species, different from the common *Mola rotunda*.

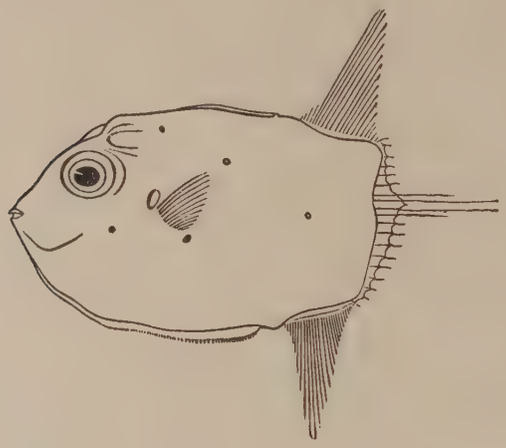

Fig. 7. *Mola lanceolata* (= *Orthagoriscus mola*, Putnam (1871)). Copy of the figure by PUTNAM (1871). Length: c. 54 mm.

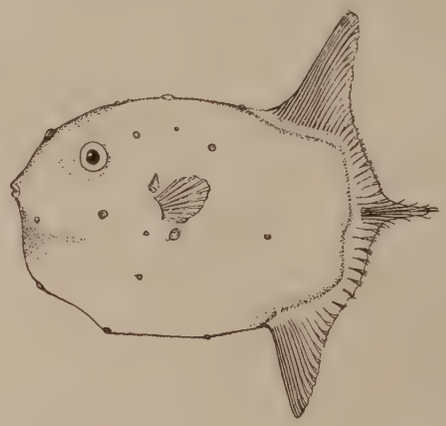

Fig. 8. *Mola lanceolata* (= *Mola rotunda*, Ryder (1886)). Copy of the figure by RYDER (1886). Nat. size.

We see from Fig. 3 Pl. I, which presents the 4 cm. long individual from the Utrecht Museum (mentioned by REUVENS 1894), that *Mola rotunda* has not the thread-like elongation of some of the caudal rays which distinguish the corresponding developmental stage of *Mola lanceolata*. One result of this is that a whole series of the abt. 3—5½ cm. long, young sun-fishes with elongated caudal rays[1] described in literature as *Mola rotunda* does not belong to the cycle of development of this species but of *Mola lanceolata*. But if this be correct, all presumptions that *Mola rotunda* passes through a stage with elongated tail (RYDER 1886 p. 1031; COLLETT 1896 p. 168) become eo ipso null and void, and the same holds good with regard to COLLETT's explanation of the Prince of Monaco's *Mola* and other pointed-tailed adult specimens belonging to *Mola rotunda* retaining in an abnormal manner a post-larval characteristic which under normal conditions disappears early (cf. p. 4, foot-note).

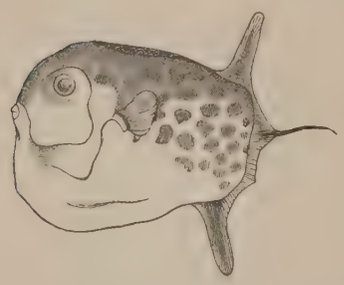

Fig. 9. *Mola lanceolata* (= *Orthagoriscus mola*, Perugia (1889)). Copy of the figure by PERUGIA (1889).

The cause of all these mistakes must be sought in the fact that most investigators have not brought into account LIÉNARD's and BLEEKER's above-mentioned pointed-tailed specimens of *Mola* found in the Indian Ocean, but have taken it for granted that the young stages found in the Atlantic must belong to the there common *Mola rotunda*. This explanation however — as mentioned in the introductory page — does not apply to STEENSTRUP & LÜTKEN. It is therefore so much more regrettable that these two writers, who first of all have understood how to keep the two groups

[1] Such as the illustrations and descriptions of PUTNAM (1871 p. 256, fig. 3, but not fig. 1), of RYDER (1886 Pl. VIII, fig. 5), and PERUGIA (1889, figure). All these figures are reproduced here in the text figures (fig. 7, fig. 8 and fig. 9.

(Figs. 1—3 and 4—6 in Pl. I) distinct from one another, in other words have recognised the specific differences within the genus *Mola*, should have the misfortune to confuse the two genera *Mola* and *Ranzania*.

We come therefore to the conclusion that the pointed-tailed sun-fish *(Mola lanceolata)* is an independent, clearly-defined species. Compared with the common short sun-fish *(Mola rotunda)* it is characterized by the following peculiarities.

It is furnished with a short, pointed tail which is a secondary formation. Abt. 7 rays in the caudal fin, just above the centre, are longer and thinner and are situated more closely together than the remaining rays. The species has a lower total of rays (9—11) in the pectorals and a higher in the unpaired fins (more than 55?) than *Mola rotunda*.

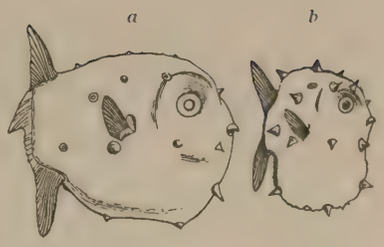

Fig. 10 a & b. *Mola lanceolata & rotunda* (= Young of *Orthagoriscus*, 32 and 18 mm. long. Günther (1880)). Copy of the figures by Günther (1880).

It attains a considerable length, 225 cm., and a weight of 337,5 kilo (Liénard). The eggs are pelagic and measure abt. 1,8 mm. in diameter. They possess many oil-globules (abt. 40). (In *Ranzania* the eggs are smaller — 1,3—1,4 mm. in diameter — and the number of oil-globules hardly exceeds 20).

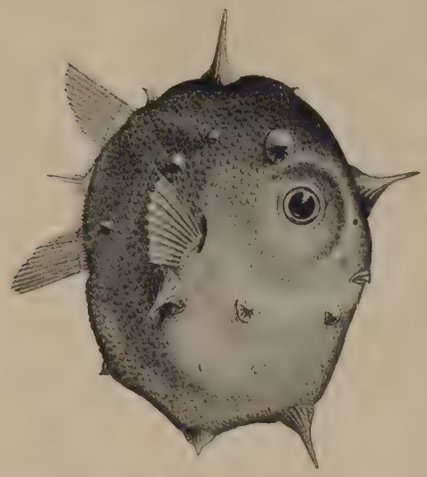

Fig. 11. *Mola lanceolata* (= *Molacanthus sp.*, McCulloch (1912)). Copy of the figure by McCulloch (1912). Length: 13 mm.

The newly hatched larvae are furnished with a primary tail, which however soon disappears (vide Text-figure 14 c, p. 12). In the young larvae none of the spines are remarkable for special length, but 5 of the spines soon grow into long horns, namely the 3 unpaired spines Nos. 1, 3 and 5 and a pair of spines (12 and 13) situated just behind the pectoral fins (Text-fig. 6 p. 7). The eye-spines (Nos. 16 and 17) are missing or rudimentary. As in the case of the *Mola lanceolata* the base is furnished with transverse ribs, which are absent in the *Ranzania* genus. The following spines are present in both species of *Mola*, but not in *Ranzania*: Nos. 7, 14 and 15, as well as the two small paired spines situated below Nos. 10 (11) and 12 (13) (v. fig. 6, p. 7).

Similarly to the other species of sun-fishes, the body in the post-larval stages is higher than long, but when it attains a length of between 25 and 30 mm., height and length are equal to each other, and already at a length of 32 mm. the creature is longer than it is high, and certain rays in the caudal fin, slightly above the middle, begin to sprout into a threadlike elongation absent in the case of *Mola rotunda* (v. Text-fig. 7—9, 10 a, 11 and Fig. 6 Pl. I). The post-larval stages of abt. 10—abt. 25 mm.s length are remarkable for the lower contour forming a distinct angle, it being curved in the case of *Mola rotunda*.

Mola lanceolata was first found in the Indian Ocean: by Mauritius (Liénard) and by Amboyna (Bleeker) and in the Red Sea (specimen from Klunzinger's collection in the Berlin Museum). A specimen 2 m. long captured west of the Azores by the Prince of Monaco has proved to belong to *Mola lanceolata*, and the same applies to several post-larval stages from the northern Atlantic, in literature described as belonging to *Mola rotunda* (by Gachet, Putnam, Ryder, Perugia, Collett) or *Ranzania truncata* (Steenstrup & Lütken).

Fig. 12. *Mola rotunda* (= *Diodon carinatus*, Mitchill (1828)). Copy of the figure by Mitchill (1828)).

Our collections, especially those from the "Dana"s cruise in 1920, contain numerous larval and postal-larval stages of development, proving that *Mola lanceolata* must be common in the Atlantic and that it propagates in the Sargasso Sea.

In the Pacific also *Mola lanceolata* occurs, for both the post-larval specimens depicted by GÜNTHER (1880 v. Text-fig. 10 a p. 11) and by McCULLOCH (1912, v. Text-fig. 11, p. 11) have proved to belong to this species.

Fig. 13. The oblong sun-fish (*Ranzania truncata*), larval stages. Length, *a*, 1,7 mm.; *b*, 1,8 mm.; *c*, 2,4 mm.; *a* hatched on board the »Dana« in the Sargasso Sea.

Fig. 14. *Mola lanceolata* (*a* and *c*), *Ranzania truncata* (*b*); *c* larval, *a* and *b* post-larval stages. Length, *a*, 5,5 mm.; *b*, 3,5 mm.; *c*, 2,8 mm.; *a* and *b* same enlargement, *c* more enlarged. Note that the tail has disappeared in *a* and *b*. — »Dana« 1920, Sargasso Sea.

In conclusion I give a list of some young *Mola* specimens mentioned in literature, which I have been able to classify. As regards the older literature I refer to STEENSTRUP & LÜTKEN, who (1896, p. 96) have given a summary, but I have included in my list all the specimens — also those mentioned by STEENSTRUP & LÜTKEN — of which the place of capture is known. In addition the list contains the cases which STEENSTRUP & LÜTKEN have overlooked or which have been described since the publication of their work.

Mola rotunda.

1. MITCHILL (1828): "*Diodon carinatus*", "washed on board the brig Ganges of Boston, in lat. 38° N. and long. 62° w. from Greenwich", "the length from the mouth to the end of the tail, scarcely an inch". Owing to its very high shape this specimen can be recognised for certain as belonging to *Mola rotunda*, and it is of special interest because it is the sole specimen of *Mola rotunda* mentioned in literature of which exact locality is given. It is not quite clear how MITCHILL's wording as regards length shall be understood, but it must be either circa 15 mm. or slightly over 20 mm. long. (Fig. 12, p. 11).

2. Putnam (1871): *"Molacanthus palassii"*, "half-grown", "stomach of a dolphin caught in the N. Atlantic." The figure (Fig. 5, p. 5) shows a length of circa 18 mm.

(Good illustrations of specimens abt. 25 and abt. 26 mm. in length are given by Richardson (1845) and Reuvens (1894) named respectively *"Orthagoriscus spinosus"*, "China Seas" and *"Orthragoriscus sp.?"* without the slightest description of locality).

Mola lanceolata.

1. Gachet (1832): *"Orthagoriscus spinosus."* "300 lieues dans l'Est du banc de Bahama." Length not quite 18 mm. (7,75 lignes) height not quite 22 mm. (9,5 lignes).
2. Putnam (1871): *"Orthagoriscus mola."* "4 specimens about 2 inches in length." "Massachusetts Bay." A specimen illustrated in "natural size", the same as the accompanying Text-fig. 7, p. 10, proves to be circa 54 mm. in length.
3. Günther (1880): *"Orthagoriscus mola."* Length 32 mm. Illustrated in accompanying Text-fig. 10 a. According to kind information from Mr. C. Tate Regan, British Museum, this specimen was captured in the Pacific, 13° lat. S., 146° long. W. (coll. Godeffroy).

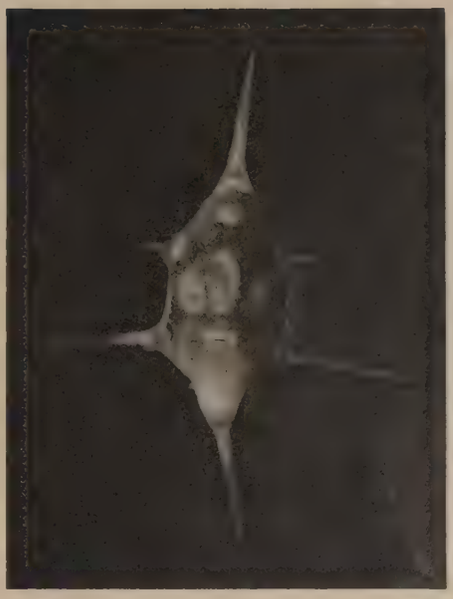

Fig. 15. *Mola lanceolata*, post-larval stage. Length 5 mm. Front view. — »Dana« 1920, Sargasso Sea.

4. Perugia (1889): *"Orthagoriscus mola."* 4 specimens taken March 1882 from the stomach of a *Coryphaena* off Santa Rosa Island, Pensacola, Florida, Gulf of Mexico. Lengths: 35, 39, 42, 50 mm. A specimen is illustrated in the accompanying Text-fig. 9.
5. Collett (1896): *"Mola mola."* 1 specimen 34 mm., from "Mer des Sargasses."
6. Steenstrup & Lütken (1898): *"Ranzania truncata."* "1 specimen, length 24 mm., captured by Captain A. Andrea in 1871 in 27° lat. N., 25° long. W. Illustrated by Steenstrup & Lütken on their Pl. IV fig. C and on accompanying Pl. I fig. 4.
7. Steenstrup & Lütken (1898): *"Ranzania truncata."* 1 specimen, length 47,5 mm. taken from the stomach of a *Coryphaena* captured off the Azores. Illustrated by Steenstrup & Lütken in their Pl. IV fig. E and in accompanying Pl. I fig. 6.
8. McCulloch (1912): *"Molacanthus sp."* 3 specimens, lengths 13, 10, 9,5 mm. Taken in the stomach of a kingfish in Central Pacific, between the Ellice and Union Islands 1911. One of his specimens (13 mm.) is illustrated in the accompanying Text-fig. 11.
9. In the Zoological Museum, Copenhagen, I have found a specimen, length 20 mm., labelled *"Mola hispida."* Lat. 21° N. Long. 40° W., Hygom, 1/5 1860. Excluding the spines its greatest height is 22,5 mm. The specimen is a typical *Mola lanceolata.* It has 10—11 pectoral rays and about 56 rays in the unpaired fins.

PLATE I.

Fig. 1.

Fig. 2.

Fig. 3.

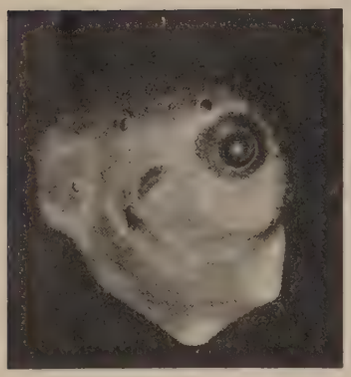

Fig. 4.

Fig. 5.

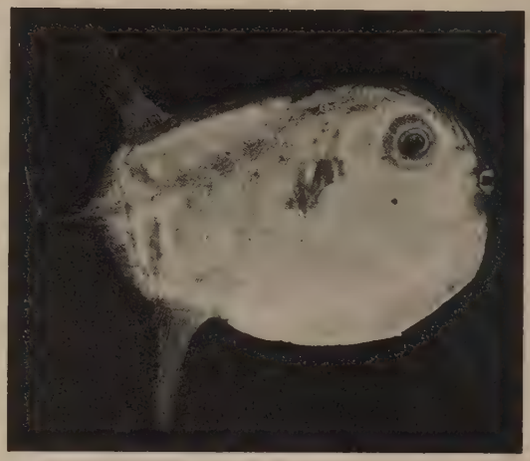

Fig. 6.

Fig. 2a.

Fig. 4a.

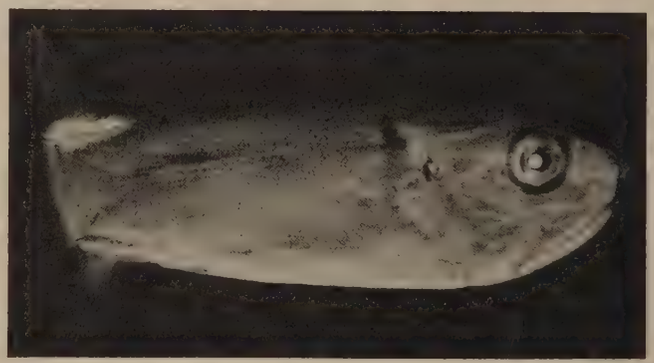

Fig. 7.

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YOUNG STAGES OF SUN-FISHES.

Fig. 1—3. *Mola rotunda.* Fig. 4—6. *Mola lanceolata.* Fig. 7. *Ranzania truncata.*

Explanation of Plate I.

Fig. 1. ***Mola rotunda.*** Museum d'Histoire Naturelle, Paris. Length 15 mm. (= *Mola rotunda,* Steenstrup & Lütken (1898) T. IV, Fig. A.).

» 2. — — Mus. d'Hist. Nat., Paris. Length 19,5 mm. (= *Mola rotunda,* Steenstrup & Lütken (1898) T. IV, Fig. B.).

» 2a. — — Front view.

» 3. — — Zoölogisch Museum, Utrecht. Length 37 mm. (= *Orthragoriscus sp. ?,* Reuvens (1894) p. 129.).

» 4. ***Mola lanceolata.*** Zoologisk Museum, København. Length 23 mm. (= *Ranzania truncata,* Steenstrup & Lütken (1898) T. IV, Fig. C.).

» 4a. — — Front view.

» 5. — — Museum d'Histoire Naturelle, Paris. Length 25 mm. (= *Ranzania truncata,* Steenstrup & Lütken (1898) T. IV, Fig. D.).

» 6. — — Zoologisk Museum, København. Length 47,5 mm. (= *Ranzania truncata,* Steenstrup & Lütken (1898) T. IV, Fig. E.).

» 7. ***Ranzania truncata.*** Zoölogisch Museum, Utrecht. Length 53 mm. (= *Orthragoriscus oblongus,* Harting (1868) Pl. II, Fig. 2.).

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